surface of the cotton wool. It is simply the temperature of the thermometer bulb itself, and is the difference between its radiation outward and the radiation inward. By covering the bulb with different substances we get effects depending upon the radiating powers of those substances.

As radiant heat is always flowing towards every exposed object, and is also flowing from that object out in all directions, we must be on our guard against its effects whenever a thermometer is to be used. A thermometer hung up in the middle of an ordinary room in which the air is perfectly still does not give the temperature of the air, but an average of the temperatures of the interior surfaces of the walls of the room, and this is wholly the influence of radiation. If we wish the thermometer to give us the temperature of the air itself, we must set the air of the room into rapid motion past the thermometer, so that it shall come into contact with the latter. When this is done the thermometer will assume a temperature that is an average between the temperature of the walls and the air. If now we wish to completely cut off the influence of the walls, we must put a small shelter around the thermometer, such as a tube through which the air of the room may be drawn; a double thin-walled tube is necessary, and a rapid ventilation, if we would annul the effects of obnoxious radiations.

In meteorological observations there are a number of objects to be attained, each of which requires a special instrument. There is the radiation thermometer, which gives us the lowest temperatures of the surface of the ground, or of the foliage at nighttime; the black and bright bulbs in vacuo, for getting the intensity of sunshine; the wet bulb, which gives the temperature of evaporation of the surface of water, and, finally, there are the air thermometers, which are intended to give us the temperature of the air at any given spot. The physician needs to know the temperature of the air in which we live, the agriculturist needs the temperature of the soil and the temperature of the leaves of the plants, but the meteorologist wishes the temperature of great masses of air in the free atmosphere. In order to attain this latter temperature the Weather Bureau thermometers are placed high up, above tall buildings, where the wind will strike them freely, and in a light, open, wooden shelter, so that neither sunshine by day nor radiation by night can affect them. Under these circumstances it is found that the air at a hundred feet above the earth's surface does not go through the same changes in temperature that are experienced near the surface; it is neither so warm in the daytime nor so cold at nighttime; the midday maximum temperature is below that near the surface, while the morning minimum is oftentimes far higher than at the earth's surface.

The low temperatures observed on March 13 and 14 at York, Pa., while much higher temperatures prevailed at Harrisburg, Baltimore and Philadelphia, undoubtedly resulted from a favorable combination of the following circumstances, namely: snow on the ground, clear sky, light winds and calms, all favoring intense local surface radiation at York, but less so in Washington, Philadelphia, and surrounding cities; a central area of high barometer favoring the local descent of cold air; the location of the thermometers near the ground in still air at York, but high above the ground in the free wind at Philadelphia, Harrisburg, and other stations.

Under similar conditions great discrepancies in the minimum temperatures at stations only a few miles apart have often occurred in other parts of the country, and local controversies have often arisen as to the errors of thermometers and the carefulness of the observers. A notable case of this kind occurred in 1882, when differences of 20° were recorded at stations a few miles apart in the Mississippi Valley. The explanation of these discrepancies was very simple as soon as it was ascertained that they occurred during a perfectly clear calm night, and that the warmer stations were on ground a hundred feet above the surrounding lowlands, which were covered with snow. In such cases no conclusions derogatory to the observers or their instruments can be drawn from the discrepancies that appear under such circumstances.

THUNDERSTORMS AND CLOUDS IN JAMAICA.

Mr. Maxwell Hall, Proprietor of the Observatory at Kempshot, in the Island of Jamaica, and well known as meteorological reporter to that colony, suggests that the following classification of clouds, which he finds very appropriate to his island, may be of wider interest. Adhering to the primary terms of Howard, namely, cirrus, cumulus, and stratus, he states that in Jamaica the average drift of these clouds is, respectively, from the east-northeast, the southeast, and the east. The combinations of clouds and descriptions given by him are as follows:

Cloud.	Description.
1. Cirrus	Fibrous threads; mares' tails.
2. Cirro-stratus	Thin sheets of fibrous texture.
3. Cirro-cumulus	Flakes; mackerel-back.
4. Strato-cirrus	Thick sheets of wooly texture.
5. Cumulus	Rounded solid masses.
6. Cumulo-nimbus	Cumulus discharging rain.
7. Alto-cumulus	Fleeces of wool; flock of sheep.
8. Alto-stratus	Watery veil.
9. Strato-cumulus	Long, rolling waves, parallel to the horizon.
10. Nimbus	Stratus discharging rain.
11. Stratus	Low horizontal sheets of smoke-like cloud.
12. Fracto-stratus	Fragments of stratus.

Mr. Hall states that a cumulus cloud in the summer months in Jamaica is often a gigantic mass, 10 miles in diameter and 6 miles high. As to the importance of separating the cirri that move from the east-northeast from the cumuli that move from the southeast, he says:

> With a slightly falling barometer and a cirro-stratus from the east-northeast, an observer would be justified in supposing that a cyclone was approaching Jamaica on the usual path from the Windward Islands, if it were not for the fact that cirro-stratus *generally* comes from the east-northeast at that time of the year. * * * As a rule, cirrus in its various forms is seen in Jamaica daily during the summer and autumn months, especially between 6 and 7 a. m., but is rarely seen during the rest of the year. * * * The cirro-stratus cloud consists of thin sheets of fibrous texture; the threads often interlace so that the cloud appears to be woven. Solar halos, mock suns, etc., are caused by the ice particles of which this cloud is composed. Cirro-stratus is always found to surround the advancing half of a cyclone, and hence its importance in forecasting the weather. * * * Fracto-stratus is the commonest cloud in Jamaica, winter and summer; its easterly drift is due to the trade wind; it extends upward to about one mile from the surface of the sea, but the lower 1,000 feet is greatly affected by land and sea breezes.

With reference to thunderstorms, Mr. Hall quotes the average number of days with thunder, as observed by the late Professor Houzeau, who lived at one time about 6 miles northeast of Kingston. The maximum average per month is 10 days in August, but Mr. Hall, from 20 years' experience. advises that these numbers must be accepted with caution, inasmuch as in thunderstorm months three or four separate storms may often be seen at the same time from a high station, like the Kempshot Observatory, so that the real number of thunderstorms for Jamaica is much larger than is indicated by Houzeau's table. As a rule, the heavier the rain the greater the thunderstorm; lightning easily strikes the earth through wet trees, and it is only in September that danger from lightning is to be apprehended. Hail does not often fall in Jamaica; tornadoes are almost unknown, and waterspouts are seldom seen at sea. It is believed that hail is often heard falling at a great height in the air, but reaches the ground as cold rain; at Kempshot, 1,773 feet above sea level, the temperature of the rain is about 65° F., which is below the usual daily morning minimum, and the anomaly of having a minimum reading occur at the hottest time of the day is got over by resetting the minimum thermometer after every such shower. At sea level the temperature of the cold rain is about 75° F., which is above the early morning minimum at that level. Under normal circumstances, the temperature in Jamaica diminishes at the rate of 1° F. for every 315 feet, but when rain is falling from a thundercloud the diminution is 1° for every 177 feet.

RECENT HIGH BALLOON ASCENSIONS.

In the Comptes Rendus of the Paris Academy of Sciences for April, 1896, Vol. CXXII, page 849, Messrs. Hermite and Besançon give the principal results of the last scientific balloon ascension which started at 11.30 a. m., March 22, after consulting the weather predictions of the Central Meteorological Bureau. The small balloon with its apparatus weighed 32 kilos. (70 pounds), and started with a vertical pull of 106 kilos. (235 pounds); consequently the balloon rose perpendicularly for three or four minutes with a steadily increasing velocity. For nearly half an hour the balloon scarcely moved from the vertical, so that the velocity of ascent certainly exceeded 5 or 6 meters (16 to 20 feet) per second. After three and a half hours the balloon descended near Cambray. The self-registers show that it attained a maximum height of 14,000 meters (42,933 feet) within about forty-five minutes after starting, and a minimum temperature of —63° C. (—81.4° F.). The temperature at the surface of the earth beneath the balloon at that moment was +14° C. (+57.2° F.). Consequently the average rate of decrease was 1° C. (1.8° F.) for 182 meters (597 feet). This value does not much exceed that found in their voyage of October 20, 1895, when the aerostate at an altitude of 15,500 meters (50,854 feet) experienced a temperature of —70° C. (—94.0° F.), while the temperature at the surface of the ground was +11° C. (+51.8° F.). The registering thermometer has been tested in a very cold inclosure, and records properly down to —80° C. (—112.0° F.).

METEOROLOGICAL TABLES.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only the 8 p. m. observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation.

Table II gives, for about 2,700 stations occupied by voluntary observers, the extreme maximum and minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station; the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (....).

Table III gives, for about 30 Canadian stations, the mean pressure, mean temperature, total precipitation, prevailing wind, and the respective departures from normal values. Reports from Newfoundland and Bermuda are included in this table for convenience of tabulation.

Table IV gives detailed observations at Honolulu, Republic of Hawaii, by Curtis J. Lyons, meteorologist to the Government Survey.

Table V gives, for 26 stations, the mean hourly temperatures deduced from thermographs of the pattern described and figured in the Report of the Chief of the Weather Bureau, 1891–'92, p. 29.

Table VI gives, for 26 stations, the mean hourly pressures as automatically registered by Richard barographs, except for Washington, D. C., where Foreman's barograph is in use. Both instruments are described in the Report of the Chief of the Weather Bureau, 1891–'92, pp. 26 and 30.

Table VII gives, for about 130 stations, the arithmetical means of the hourly movements of the wind ending with the respective hours, as registered automatically by the Robinson anemometer, in conjunction with an electrical recording mechanism, described and illustrated in the Report of the Chief of the Weather Bureau, 1891–'92, p. 19.

Table VIII gives the danger points, the highest, lowest, and mean stages of water in the rivers at cities and towns on the principal rivers; also the distance of the station from the river mouth along the river channel.

Table IX gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in any geographical division one may obtain the average resultant direction for that division.

Table X gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table XI gives, for 38 stations, the percentages of hourly sunshine as derived from the automatic records made by two essentially different types of instruments, designated, respectively, the thermometric recorder and the photographic recorder. The kind of instrument used at each station is indicated in the table by the letter T or P in the column following the name of the station.

Table XII gives the record of excessive precipitation at all stations from which reports are received.

Table XIII gives a record of the heaviest rainfalls for periods of five and ten minutes and one hour, as reported by regular stations of the Weather Bureau furnished with self-registering rain gauges.

Additional information concerning the tables will be found in the REVIEW for January, 1895.

NOTES EXPLANATORY OF THE CHARTS.

Chart I.—Tracks of centers of low pressure. The roman letters show number and order of centers of low areas. The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the 8 a. m. and 8 p. m., seventy-fifth meridian time, observations. The queries (?) on the tracks show that the centers could not be satisfactorily located. Within each circle is given the lowest barometric reading reported near the center. A blank indicates that no reports were available. A wavy line indicates the axis of a trough or long oval area of low pressure.

Chart II.—Tracks of centers of high pressure. The roman letters show number and order of centers of high areas. The figures within the circles show the days of the month; the